Loetschberg-Tunnel:

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Air conditioning and refrigeration technology of highest quality and dependability

As far as safety is concerned, the BLS Alp Transit AG place absolute emphasis on long-term safety for the users of the 34.6 km long Loetschberg Base Tunnel from Frutigen to Raron, i.e. on a high level of technical safety for the infrastructure needed for the operation of a tunnel.

In the planning of installation and safety measures in the technical control centres located in eight galleries (H 13 x L 100 x W 30 metres), it was the shock waves caused by the trains passing with a planned top speed of up to 220 km/h along with difficult climatic conditions (heat and dampness) that were very difficult to solve which could only be cracked on time by a specialised company with special experience in this area.

"LUSS": The air channelling safety system for railway tunnels

The problems posed by shock waves for technical installations in railway tunnels increase continually with the increasing number of high speed trains. As a solution for such problems, the Wintsch AG company in Muenchenstein, Switzerland, has developed a system that protects technical service installations from pressure waves caused by passing trains. At the same time, of course, the optimal and continuous functioning must be guaranteed. Thanks to the "LUSS" system, maintenance and repair costs can be kept low and the reliability of the ventilation and cooling equipment can be considerably improved. For security reasons, the customer – BLS Alp Transit company – has demanded a certain amount of discretion, which means that not all details of the installations can be discussed here.

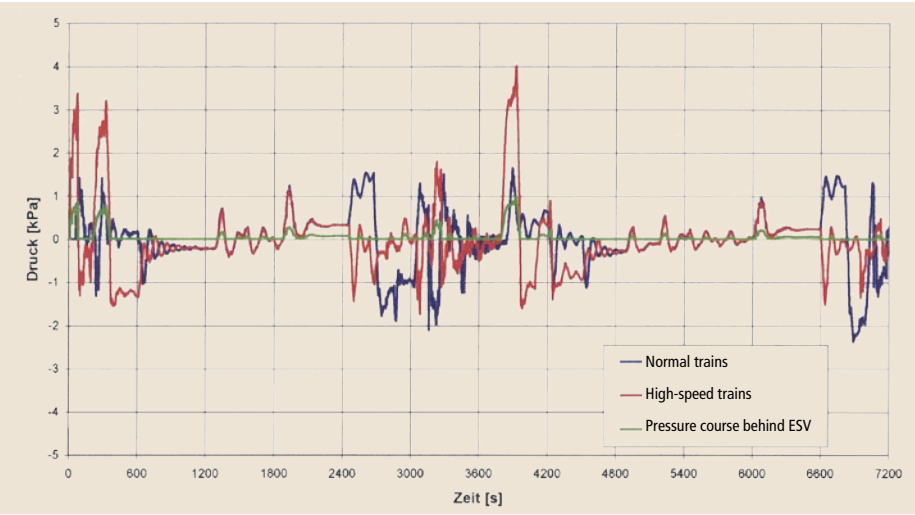
LUSS: System description

All ventilation installations in the galleries (next to railway tunnels) with an exchange of air with the tunnels, i.e. that draw in air from or expel air to a tunnel, are equipped with explosion protection valves (EPV). The trains passing by close the EPV and thus prevent a shock wave reaching the air ducts and the ventilation equipment.

During the period when the EPV closes off the ventilation system, the installations behind it are switched over to re-circulation operation. The spent air from the galleries is returned to an air conditioning control centre. The air conditioning unit in the centre closes the fresh air flap and opens the re-circulation flap, thus directly sucking in the air fed back to the unit. In this way, a constant supply of air is guaranteed for all the containers located in the galleries. The tunnel operating Company requires that all containers situated in the galleries be constantly pressurised in order to protect them from dirt and dust.

The change over is effected using flaps with fast pneumatic drives with a maximum closing time of 1 to 2 seconds. The opening and closing of the flaps is activated by proximity switches fitted to the explosion protection valves. As the change over has to happen very quickly, a pneumatic system was chosen that provides a constant supply of compressed air and takes responsibility for opening and closing times of less than 1 second. The whole ventilation and air conditioning system for the tunnel's technical installations is implemented with 100 % redundancy.

This diagram illustrates the pressure conditions in the railway tunnel (red = high speed trains, blue = normal trains, green = pressure behind the EPV)



Companies involved in the "Container" project

Planning + development: Wintsch AG
Installation: Wintsch AG
Control and instrumentation planning: MST AG
Air-conditioning units: Seven-Air AG
Lamella dampers: Lucoma AG
Fire-protection flaps: Lucoma AG
Flap drives: Belimo AG
Refrigeration: Ciat AG
Plastic fans: Colasit AG
Stainless-steel radial fans: Ferrari / Bonotec
Filters (F7, F9 and F11): Unifil AG
Electric motors: Elektro Motoren Werke Brienz
Circulation pumps: Biral
Refrigeration compressors: Ciat
Pipe-bundle heat-exchangers: Ciat
DDC control: Saia–Burgess
Peripherals: Sensortec
Electrical control cabinets: ABC Elektrotechnik

A quick look at the special components

As a result of a special effort made by the Wintsch company, involving up to 25 fitters (only professional specialists and apprentices), 134 stainless steel containers (general technical and air conditioning control centres) were completely fitted out in just six months. Up to six to eight re-circulation air conditioning units per week were delivered to the specially rented container workshop. Hundreds of drives, valves, fire protection flaps, control units, pumps, condensate pumps etc with a book value of around 10.5 million Swiss Francs were installed.

Installation in the galleries

Working together with the purchaser, the 134 stainless steel containers will be tested from January until July 2005 up to the interface with the overall control system. Afterwards, the systems will be taken apart and transferred to the tunnel, where they will be put together, wired up and installed again from October 2005 onwards (illustrations 4 and 10). Afterwards, the final commissioning will be carried out on site.

This somewhat unusual and enormously expensive approach offers advantages as far as fitting and testing is concerned as well as minimising risks as far as deadlines are concerned. The technical equipment has to be installed and commissioned very quickly in the galleries as soon as possible, since the units will be put operational from 2006 onwards and the connections to the control rooms in Frutigen, Raron and Spiez have to be checked out over a long period of time. Each gallerie houses around 15–20 containers. These contain the "heart and soul" of the tunnel equipment. Technology and safety at the highest level is aimed for - also in connection with the ventilation and air conditioning systems for the protection of the numerous complex technical units. In the Galleries themselves, climatic conditions exceed temperatures of over +35 °C and, in part, over 75 % relative humidity. All containers are fully air conditioned for constant room conditions of +25 °C to +28 °C and 55 % relative humidity. For the air condi-

Illustration 1: Part view of the large construction shed with a height of 11.5 metres in which the 134 containers are fitted out by the Wintsch company.

Illustration 2: In the middle of the up to 24.5 metre-long containers, even the 1.8 metre wide monoblocs for fresh and spent air look lost.

Illustration 3: Prefabricated, vertically-mounted re-circulation cooling units are connected to the false floor.

Illustration 4: For the dismantling in Bern and installation in the galleries, the containers have to be dismantled into units with a maximum width of 2.28 metres (illustrations 4 and 10, shown in yellow). The definition of the appropriate interfaces is a delicate and extremely costly job. Also, a lot of attention has to be paid to additional securing mechanisms for transport.

Illustration 5: Guaranteeing clean air conditions in cramped conditions is no easy job: Filter housings in stainless steel and F5 coarse filters / F9 fine dust filters as a first stage in front of the monoblocs (left) and F9/150 mm fine dust filters in the monoblocs. In areas with electronic components filter class H11 is used.

Illustration 6: Plastic fans (in redundant configuration) in the battery container.

Drive motors (Elektromotorenwerke Brienz) to Eex-e-II-T3 standards conform to Atex 2. Impeller and housing consist of flame-resistant, electrically conducting thermoplastic.

tioning of the tunnel's technical equipment over 2,000 kW of cooling is needed – using drainage water in the tunnel and air cooling outside the tunnel.

Specially-designed air conditioning units

For space reasons, all monoblocs delivered by Seven Air were individually made to measure so that they could be exactly fitted in the various containers to the millimetre. The vertical re-circulation cooling units are connected to a false floor. The twin fresh air units with stainless-steel bottom panels are mounted horizontally. The control cabinets – also in stainless-steel – are integrated in the monoblocs. The capacities of the units depend on the type of container and range from 500 to 5,000 m³/h, and 3 kW to 30 kW of cooling power respectively. The units were delivered to the container workshop completely wired and with all necessary piping already installed.

Lamella dampers: over 720,000 cycles

Lucoma's lamella dampers in stainless steel are resistant to aggressive atmospheres and temperatures of up to 120 °C and can (with guarantied functionality) be used at operating temperatures of +60 °C. For the Loetschberg tunnel a very fast closing time and stricter product guarantees requirements were specified. For this reason, operational tests (open/close) have now been running on these dampers since March 2003. By the middle of November 2004 around 720,000 movements had been made. These tests are still continuing (Illustration 9). The fire protection dampers supplied by Lucoma are also in stainless steel and comply to fire-protection class K90.

Actuators and regulator ball valves

The re-circulation air conditioning units from Seven-Air are controlled by Belimo characterized control valves (CCV). These possess an equal percentage characteristic (according to VDI/VDE 2173). The Belimo CCV's close air – bubble tight and no leakage occurs. This is very important for the Loetschberg project, as the systems are built to be redundant. This means that no energy is lost and no false circulation can occur. The compact and robust construction of the characterized control valves aids easy fitting and, in particular, easy insulation – both important advantages for fitting in the very cramped container space. The NRY24-SR drives are fitted with an anti-blocking function and thus guarantees that the CCV's still function perfectly even after long periods of standstill. All drives are fitted with halogen free cabling.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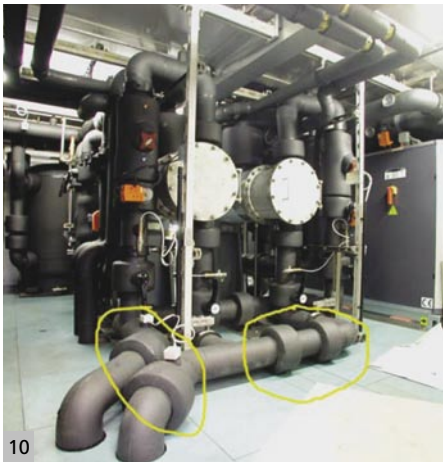
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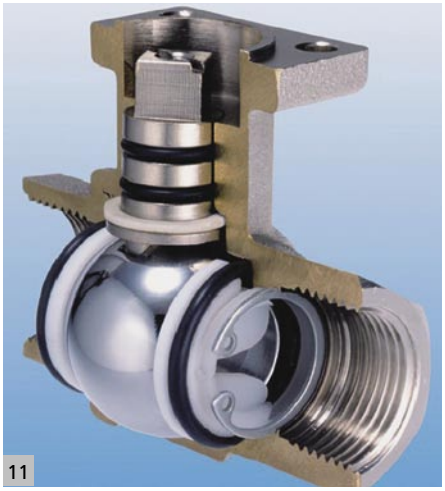
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Illustration 7: All fresh air inputs and air outlets to and from the containers are protected by fire protection flaps in stainless steel.

Illustration 8: In order to keep fire loadings and installation work as low as possible, model BFG24TL-T-ST MP-bus drives were used on the Lucoma fire protection flaps. These communicate with the control system using a BKN23-24-LON unit via LON-Bus.

Illustration 9: Test installation for the lamella dampers (used after explosion valves/before containers): Stainless steel Reglair dampers. Right-hand side: Over 720,000 movements up to now in 5-second intervals using a special motor. The manufacturer forecasts at least 2.5 million movements for this type of damper!

Illustration 10: Dismantling joints are also needed for refrigeration equipment.

Illustration 11: The Characterized control valves have an equal percentage characteristic (according to VDI/VDE 2173) and close air bubble tight. No leakage occurs, meaning that no energy is lost and no false circulation can occur.

Multi stage air filtration

For Seven Air's external units, filter housings in stainless steel were provided by the Unifil company as first stage filters in front of the monoblocs.
Filter classes: F5 coarse filter with Turbofil TUT F9 fine dust filter including tensioning device. Turbofil TU F9/150 mm fine dust filters are fitted in the monoblocs. In areas with electronic components filter class H11 is used.
Unifil's Swiss manufacturing of both filter housings and filters was, in connection with quality and spares guarantee aspects, an important factor in the buyer's choice.

Plastic fans in the battery containers

Because of the danger of possible acid spills, Colasit CMV 225 plastic fans with ATEX certificate for use in Zone 2 are fitted in the battery containers. Thanks to Colasit's basic construction methods, the direct drive fans are fixed to the ceiling using standard stainless steel support frames. The connections to the stainless steel ducting are made using acid-resistant sleeves made of EPDM (ethylene-propylene-diene-rubber). Fan capacities range from 400 m³/h to 4,800 m³/h and pressures from 200 Pa to 1,800 Pa are dealt with. ■